

Redox Reactions and Electrochemistry

9.3 Oxidation Numbers (only first half, assigning ox numbers)

Electrochemistry: Interconversion of electrical and chemical energy using redox reactions

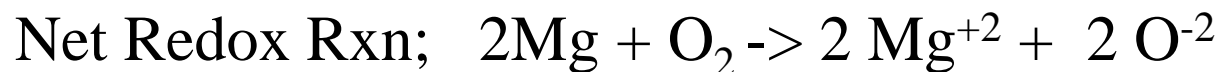
Redox (Oxidation-Reduction) Reaction: Type of electron transfer reaction. One substance gives up electrons; the other accepts electrons.

OIL RIG

•**Oxidation Half-Reaction**; Oxidation Involves Loss of electrons



•**Reduction Half-Reaction**; Reduction Involves Gain of electrons



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Oxidation Numbers of Elements in Their Compounds

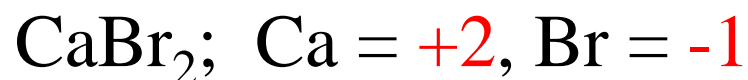
Oxidation Numbers of Elements in Their Compounds

1 1A	2 2A											13 3A	14 4A	15 5A	16 6A	17 7A
1 H +1 -1												5 B +3	6 C +4 +2 -4	7 N +5 +4 +3 +2 +1 -3	8 O +2 -1 -2	9 F -1
3 Li +1	4 Be +2											13 Al +3	14 Si +4 -4	15 P +5 +3 -3	16 S +6 +4 +2 -2	17 Cl +7 +6 +5 +4 +3 +1 -1
11 Na +1	12 Mg +2	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B					
19 K +1	20 Ca +2	21 Sc +3	22 Ti +4 +3 +2	23 V +5 +4 +3 +2	24 Cr +6 +5 +4 +3 +2	25 Mn +7 +6 +4 +3 +2	26 Fe +3 +2	27 Co +3 +2	28 Ni +2	29 Cu +2 +1	30 Zn +2	31 Ga +3	32 Ge +4 -4	33 As +5 +3 -3	34 Se +6 +4 -2	35 Br +5 +3 +1 -1

Oxidation number

The charge the atom would have in a molecule (or an ionic compound) if electrons were completely transferred to the more electronegative atom.

1. Oxidation number equals ionic charge for monoatomic ions in ionic compound



2. Metal ions in Family A have one, positive oxidation number; Group IA metals are +1, IIA metals are +2



Oxidation number, continued

The charge the atom would have in a molecule (or an ionic compound) if electrons were completely transferred to the more electronegative atom.

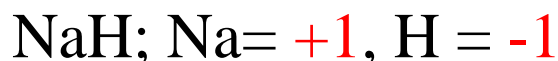
3. The oxidation number of a transition metal ion is positive, but can vary in magnitude.
4. Nonmetals can have a variety of oxidation numbers, both positive and negative numbers which can vary in magnitude.
5. Free elements (uncombined state) have an oxidation number of zero. Each atom in O_2 , F_2 , H_2 , Cl_2 , K, Be has the same oxidation number; **zero**.

6. The oxidation number of fluorine *is always* **-1**.
(unless fluorine is in elemental form, F_2)

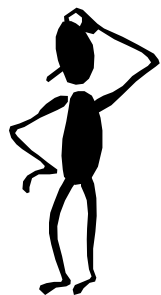
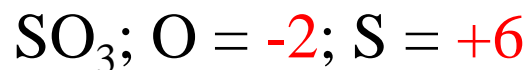
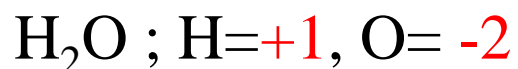
7. The sum of the oxidation numbers of all the atoms in a molecule or ion is equal to the charge on the molecule or ion.



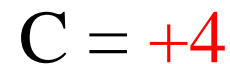
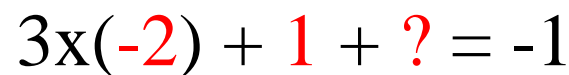
8. The oxidation number of hydrogen is **+1** *except* when it is bonded to metals in binary compounds. In these cases, its oxidation number is **-1** *or* when it's in elemental form (H_2 ; oxidation # = 0).

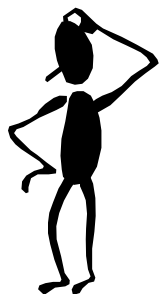


9. The oxidation number of oxygen *is usually* **-2**. In H_2O_2 and O_2^{2-} it is **-1**, in elemental form (O_2 or O_3) it is **0**.



Oxidation numbers of all
the atoms in HCO_3^- ?





Oxidation numbers of all
the elements in the
following ?



$$\text{F} = -1$$

$$7x(-1) + ? = 0$$

$$\text{I} = +7$$



$$\text{Na} = +1 \quad \text{O} = -2$$

$$3x(-2) + 1 + ? = 0$$

$$\text{I} = +5$$



$$\text{O} = -2 \quad \text{K} = +1$$

$$7x(-2) + 2x(+1) + 2x(?) = 0$$

$$\text{Cr} = +6$$

+1	+5	-6	+2	+12	-14	-4	+6	-2	+1	-1	+2	+5	-8
+1	+5	-2	+1	+6	-2	-2	+1	-2	+1	-1	+1	+5	-2
HNO ₃			K ₂ Cr ₂ O ₇			C ₂ H ₆ O			AgI		H ₂ PO ₄ ⁻		